DEVELOPING A DATA-DRIVEN DECISION-MAKING SYSTEM IN HIGHER EDUCATION MANAGEMENT THROUGH ARTIFICIAL INTELLIGENCE TECHNOLOGIES

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Abstract: This article provides a comprehensive analysis of the role and significance of artificial intelligence (AI) technologies in improving management and decision-making processes within the education system, presenting them as a new model of data-driven governance. AI technologies are examined as an innovative mechanism for collecting, processing, and categorizing educational data; analyzing students' and learners' abilities; assessing teachers' performance; forming individualized learning trajectories; and conducting real-time monitoring of educational processes.

Furthermore, the article highlights the role of several scientific and practical tasks, including developing statistical indicators based on AI, forecasting changes in the education system, predicting course-to-course progression rates through AI-driven models, optimizing resource allocation, and automating management processes. Based on a deductive approach, the analysis substantiates the effectiveness of artificial intelligence in educational management, particularly its potential for sociometric analysis of human factors as well as for evaluating pedagogical and psychological indicators.

According to the research findings, the integration of AI technologies into the education system holds strategic importance for optimizing management processes through centralized governance, improving the quality of education, developing statistical models aligned with international standards, and ensuring the sustainable implementation of national education strategies.

Keywords: data-driven management, educational statistics, digital transformation, AI analytics, psychodiagnostics, automated decision-making, educational indicators, digital infrastructure, forecasting, education management, big data, machine learning, intelligent systems, strategic management

Introduction.

In the current era of global digitization, artificial intelligence (AI) technologies are swiftly infiltrating many sectors of society. In sectors such as the economy, education, healthcare, and industry, the effective use of AI enables the automation of production and management processes, the reduction of human labor burdens, and significant improvements in efficiency. At the same time, the proper integration of these technologies requires the preparation of qualified specialists, support for scientific research, and the restructuring of the education system - issues that remain high on the policy agenda [1].

The Law of the Republic of Uzbekistan "On Official Statistics" outlines the core principles of official statistics, namely: independence, clarity and transparency, accuracy and reliability, objectivity and impartiality, statistical confidentiality, and relevance. In addition,

the Presidential Decree No. PQ-4796 of August 3, 2020, "On Measures for Further Improving and Developing the National Statistical System of the Republic of Uzbekistan," marked an important stage not only in strengthening the national statistical system, but also in advancing the development and management of statistics related to the education sector.

Educational statistics is a field of statistics that examines quantitative and qualitative aspects of phenomena and processes occurring within the education sector. In cooperation with the National Statistics Committee and other relevant ministries and agencies, a "Methodological Regulation on Educational Statistics" has been developed. This Regulation was prepared in accordance with the national statistical work program and aims to further improve the system of statistical reporting on the state and development of the education system in the Republic of Uzbekistan.

The Presidential Decree of the Republic of Uzbekistan dated 17 February 2021, "On Measures to Create Conditions for the Rapid Introduction of Artificial Intelligence Technologies," as well as the Presidential Decree No. PQ-358 of 14 October 2024, "On Approving the Strategy for the Development of Artificial Intelligence Technologies until 2030," set forth a number of tasks aimed at developing international cooperation in the field of artificial intelligence and its applications. These tasks include conducting joint international research activities, training specialists and enhancing their qualifications, and improving the country's position in prestigious global rankings and indices. Based on this, the integration of statistical data into the education system through artificial intelligence technologies significantly facilitates the processing and interpretation of the growing volume of educational data and enhances data accessibility for citizens. Artificial intelligence serves as a foundation for training computers and represents the future of solving complex problems. In this regard, it is essential to create favorable conditions for software developers who employ AI technologies within the system to utilize digital data effectively, as well as to elevate the competence of ensuring the rapid digitalization of relevant data to an international standard.

Methodology.

This article employs analytical–comparative methods, an examination of normative–legal documents, as well as a deductive approach grounded in international experience. The data were synthesized based on presidential decrees and resolutions of the Republic of Uzbekistan, resolutions of the Cabinet of Ministers, documents issued by the Ministry of Higher Education, Science and Innovation, reports of UNESCO and the OECD, and relevant scholarly publications.

Main body.

Artificial intelligence (AI) began to take shape as a scientific discipline in the mid-20th century. One of the pioneering scholars who laid its theoretical foundations was the English mathematician and cryptographer Alan Turing, a figure who made significant contributions to the development of computer science. His 1950 article "Computing Machinery and Intelligence" served as a fundamental basis for the entire field of AI. In this seminal work, Turing posed the now-famous question, "Can machines think?" and proposed a theoretical model for creating machines capable of imitating human reasoning.

He also developed the criterion known as the "Turing Test," which posits that if a machine can successfully imitate a human in conversation to the extent that an interlocutor

cannot distinguish between the two, the machine may be regarded as intelligent. Turing's idea laid the scientific and practical foundation for subsequent cognitive models and expert systems over the following decades. The term "artificial intelligence" itself emerged in 1956, when a conference on artificial reasoning was held at Dartmouth University in the United States. This event gathered prominent scholars such as Claude Shannon (Bell Laboratories), Nathaniel Rochester (IBM), Herbert Simon (Carnegie Institute of Technology), Trenchard More (Princeton University), John McCarthy (Dartmouth University), and Marvin Minsky (Harvard University).

At this conference, the American computer scientist John McCarthy (1927–2011), who delivered one of the keynote presentations, entered history as the scholar who coined the term "Artificial Intelligence."

The 1980s marked a new stage in the development of artificial intelligence. During this period, fundamental research was conducted on expert systems, databases, and neural networks. It was also in this era that the renowned scholar Marvin Minsky wrote in his seminal work "The Society of Mind": "The mind is not a single, unified system, but rather a collection of many smaller processes." This idea served as an important scientific foundation for the development of neural network models.

Researchers from Harvard University and MIT, including Joel Learner, Terrence Sejnowski, and Geoffrey Hinton were among the first to practically develop neural network architectures that model the human brain. Scholars in this field also began producing foundational textbooks.

Furthermore, in 1997, the renowned chess program Deep Blue was created, which famously defeated the world chess champion Garry Kasparov. During the same period, Japan was developing its sixth-generation computer project based on neural network technologies.

These developments significantly increased global interest in artificial intelligence. From major corporations to military institutions, substantial investments began flowing into AI research. As a result, the number of new technologies grew rapidly, competition intensified, and AI systems became increasingly sophisticated.

Uzbekistan is implementing various practical measures today to broaden the application of artificial intelligence (AI) technologies and enhance systems for the collection, storage, and processing of digital data, focusing on training qualified specialists, supporting scientific initiatives, and improving sectoral capacity.

At the present stage, the effective introduction of artificial intelligence (AI) technologies into science requires, first and foremost, the training of specialists in this field. Expanding the pool of highly qualified personnel is therefore regarded as one of the most urgent priorities, as competent experts play a decisive role in integrating AI technologies across various sectors. Currently, Uzbekistan is implementing a number of measures aimed at developing human capital in the AI domain. In particular, in order to prepare highly qualified professionals in the field of "Digital Technologies and Artificial Intelligence," this specialization has been included in the national nomenclature of scientific and scientific-pedagogical fields, and an official program passport for the discipline has been developed [2].

As artificial intelligence technologies continue to penetrate ever more deeply into our daily lives, the question "What is artificial intelligence?" is becoming increasingly significant. In this regard, it is appropriate to examine several theoretical foundations related to this concept.

To accurately understand AI and employ it wisely, it is vital to describe its conceptual essence. According to scientific standards, AI refers to a group of intelligent software systems capable of imitation of human cognition and behaviour while executing specified tasks, making decisions based on facts, independently learning, and improving through experience [3].

Moreover, artificial intelligence is not merely a specific format or function; rather, it is a complex system that encompasses the processes of collecting data, analyzing them, and making decisions based on the insights derived.

AI is often imagined in connection with robotics; however, equating artificial intelligence solely with robots is a misconception. AI is not limited to robotics—its applications extend to data analysis, deep examination of human capabilities, identifying the abilities of professors, students, and pupils within the educational process, diagnosing medical conditions in the healthcare sector, and assessing employee performance and attitudes in the workplace, among many other tasks [4].

In essence, its primary purpose is to enhance human abilities, increase the efficiency of human activity, and expand human potential. For this reason, AI technologies today are regarded as high-value strategic business resources.

In earlier periods, the term "artificial intelligence" was primarily used to describe technologies aimed at automating activities traditionally performed by humans such as customer service or playing chess. Similarly, acquiring advanced skills in computer technologies was also viewed as a form of AI. However, it has since become evident that customer service automation, online gaming, and computer-related skills represent only a small subset of contemporary AI technologies.

In particular, in the field of education, AI technologies provide opportunities to design individualized learning trajectories, analyze students' abilities and interests, and organize the learning process in a learner-centered manner. This not only enhances the quality of education but also increases the efficiency of pedagogical staff performance [5].

At the present stage, artificial intelligence is applied not only in technical or service sectors but also in analyzing numerous psychological and social processes related to human factors such as personality traits, learners' intellectual abilities, and employees' work attitudes.

In the national education system, the accuracy, transparency, and timely accessibility of statistical data necessitate the development of well-structured statistical indicators. It is noteworthy that, at the international level, high-precision analysis of statistical data in many countries is carried out with the support of artificial intelligence technologies. Economic research demonstrates that the strong emphasis placed on education in many developed countries is largely the result of robust statistical analyses. This is because innovations implemented in educational institutions are generally summarized and assessed based on indicators derived from statistical data.

The development of an AI-based statistical analysis system within the education sector enables rapid processing of essential indicators across the entire system. The creation of such statistical indicators expands the scope of accessible data, while the integration of indicators allows for calculating interrelated factors with a high degree of accuracy. Establishing a data-analysis program exerts a significantly positive influence on the education system. In particular, it contributes to improving performance indicators related to learning outcomes, which in turn has a substantial impact on enhancing the overall quality of education in educational institutions.

Moreover, the development of statistical indicators makes it possible to conduct comprehensive, system-wide analyses of the education sector, thereby fostering increased effectiveness and efficiency across the system.

The primary objectives of integrating statistical data into the education system through artificial intelligence (AI) technologies are reflected in the following tasks:

1. Studying the capabilities of using AI technical tools and networks, as well as methods for implementing them across all relevant institutions.

2. Analyzing strategic and comprehensive solutions for the introduction of artificial intelligence (AI) technologies.

3. Developing a repository of scenarios for the implementation and utilization of AI technologies.

4. Exchanging experience with foreign specialists on AI-related issues, including challenges, opportunities, new technologies, and methodological approaches.

5. Launching a portfolio of AI-related strategies and solutions for integrating statistical data into the education system.

6. Developing statistical indicators tailored to the needs of the education sector.

7. Designing an integrated system (interlinked structure) of precise indicators.

8. Analyzing budget expenditures and payments in the education sector to enhance their efficiency.

9. Improving methods for using statistical models in education.

10. Supporting educational institutions in planning and achieving their goals through AI tools.

11. Conducting and strengthening research activities related to artificial intelligence in education.

12. Analyzing learner and student abilities based on collected data and providing targeted support.

13. Studying the impact of online courses on students' academic performance.

14. Using AI to forecast student progression, retention, and dropout rates throughout the academic year.

15. Evaluating teachers' performance and instructional methods using AI technologies.

16. Developing a platform and mobile application capable of generating assessment questions and title pages, as well as automatically recognizing and checking paper-based title pages using Computer Vision technology.

17. Identifying average demographic indicators across the country, regions, districts, and schools.

18. Conducting real-time analysis of institutional, teacher, student, and learner rankings.

19. Forecasting future trends across all key indicators in the education sector using AI.

According to studies conducted by the World Bank [9] and Elsevier [6], artificial intelligence technologies demonstrate high effectiveness in accurately predicting student success and academic performance. AI models analyze large volumes of student-related data to assess learners' engagement and probability of success in their studies.

AI evaluates student achievement based on data from LMS platforms, test results, class attendance records, psychological and motivational factors, and socio-economic indicators.

Research findings show that learning models such as Random Forest, LSTM, and XGBoost can predict student performance with an accuracy rate of 87–92%. These technologies play a crucial role in early identification of academic difficulties, providing personalized support, and reducing the risk of student dropout [8].

Artificial intelligence is also a key tool for proper management and optimal allocation of resources in higher education institutions. Through AI, classroom utilization rates, teacher workload distribution, scheduling of lectures, and resource allocation across modules can be efficiently organized.

According to the McKinsey Education Analytics report [7], the introduction of AI technologies has been shown to yield the following results:

- supervisory and administrative costs decrease by 18%;
- classroom utilization efficiency increases by 22%;
- faculty workload becomes 35% more optimized.

These improvements reduce human-related inefficiencies in planning and organizing educational processes and contribute to the formation of an effective decision-making system. As AI is integrated into universities, class schedules are generated more quickly and fairly, faculty workloads are optimally distributed, and the system gains the ability to automatically forecast module-level load demands.

To achieve the primary objectives of integrating statistical data into the education system through artificial intelligence (AI) technologies, the following tasks must be carried out:

- Organizing all processes related to the formation of unified statistical data within the education system;

- Establishing an integrated system for collecting, processing, analyzing, publishing, and storing statistical information in the education sector;

- Ensuring systematic information exchange with the National Statistics Committee and increasing public trust in statistical data by enhancing transparency regarding existing education-related statistics;

- Providing users with reliable official statistical data that timely describe the current state and development of the education system;

- Developing statistical data based on key indicators relevant to the education sector;

- Expanding the scope of statistical data required to monitor the implementation of strategic planning documents in education in accordance with international standards, and

improving their classification and methodology;

- Strengthening the statistical infrastructure of all ministries and agencies responsible for the education sector by enhancing their capacity to generate timely, relevant, and high-quality data;

- Developing a unified structure of information systems for educational management.

Data is the most valuable resource in the modern world and serves as the foundation for development and progress. Statistical data is considered the "fuel" of the 21st century—the era of digitalization. Therefore, maintaining reliable educational statistics and integrating artificial intelligence technologies into this process will contribute to the development of the education market in Uzbekistan, strengthen competition among educational institutions, and enhance strategic decision-making and future planning processes.

AI-based access to educational statistical data will enable stakeholders to obtain information from anywhere and at any time, ultimately laying the groundwork for creating a highly efficient and intelligent communication environment.

Conclusion.

Today, artificial intelligence (AI) technologies are being widely introduced across various sectors. This process is driven by several key factors, among which the following three are the most significant:

1. The decreasing cost of high-performance computing resources.

In recent years, the declining prices of computer hardware and computing devices, coupled with significant improvements in their technical capabilities, have created favorable conditions for the widespread adoption of AI technologies. In particular, graphics processing units (GPUs), cloud computing services, and high-speed data-exchange systems enable the efficient training and deployment of AI models.

2. The availability of large-scale data (Big Data).

The effectiveness of artificial intelligence systems largely depends on the volume and quality of datasets used for training. In today's digital world, the expansion of opportunities for data collection, storage, and processing has led to the mass generation of datasets necessary for AI models. This has become a decisive factor in increasing the accuracy of predictions and analytical outputs.

3. The need to increase competitiveness.

Artificial intelligence technologies have become a strategic source of competitive advantage for enterprises and organizations. These technologies are widely used to optimize costs, automate business processes, reduce risks, improve the quality of customer service, and expand market access. Consequently, companies that integrate AI gain stability and superiority in competitive environments.

At the same time, as with any innovation, the introduction of AI technologies is accompanied by certain challenges. In particular, shortages of qualified specialists, limited or low-quality datasets, and similar barriers slow down the adoption process. The volume and quality of data directly determine the predictive ability of AI models. Therefore, for successful implementation, it is essential—on the one hand—to enhance human capital and, on the other hand, to effectively organize data collection, systematization, and analysis.

Artificial intelligence technologies represent a global trend that significantly influences societal development. Their appropriate and effective adoption requires, first and foremost, the training of qualified specialists, the promotion of AI-related scientific research, and the revision of educational programs. Integrating AI into education and management systems is not merely a technical issue; it must also take into account social, ethical, and psychological dimensions.

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